NOTES

EMANCIPATION FROM THE LIMITATIONS OF THE ORGANIC

Dr. Werner Sombart, of the University of Breslau, has recently produced two works of first-rate importance in the field of economics.[1] In the first he has dealt with the development and nature of capitalism and has attempted to estimate its effect on modern economic life. In the second work he has described the economic development of Germany during the last century and has sought to bring out clearly the fundamental causes of this development. Naturally, he has found in this latter study an opportunity for the testing in a concrete case of the theories propounded in the earlier publication.

The last-published book may be distinguished from the usual reviews of economic history by the care with which the author has sought to go below the visible phenomena to the underlying causes and to arrange these causes into an orderly series of principles of economic development. The application of steam and electricity to industry and transportation, the discovery of new processes in iron and steel production, are merely manifestations of still more fundamental principles.

The first principle on which modern industrial development is based is *the application of natural science to technique,* the change from empirical to scientific processes. The conduct of industrial processes is no longer an art, but a science, resting on exact calculations. In former times the knowledge and skill necessary to accomplish an industrial process were in a peculiar sense the personal property of the master-workman, and not to be transmitted except by personal instruction from him; the "mysteries" of the trade were known only by the chosen few who had been initiated into their secret; in modern times the industrial processes are a matter of exact formula and calculation, and the "I know" has replaced the "I can." Man has

[1] *Der moderne Kapitalismus.* By Dr. Werner Sombart. 2 vols. Leipzig: Dunker & Humblot, 1902.

Die deutsche Volkswirtschaft im neunzehnten Jahrhundert. By Dr. Werner Sombart. Berlin: Georg Bondi, 1903.

learned not only *how* to bring about certain results, but he has learned *why* they happen. The physicist and the chemist are concerned with this *why* of natural phenomena. It is only the last century that has seen really great progress in the sciences of physics and chemistry, and it is only the latter part of that century that has seen the systematic application of their results to industry. Such contributions to knowledge as Lavoisier's *Theory of Combustion* (1780) and Robert Mayer's *Law of the Conservation of Energy* (1841) are epoch-making for technique, and are in large measure prerequisite to the invention of special machinery or the discovery of special processes. While many inventions have been purely empirical — Huntsmann and Friedrich Krupp, the inventors of cast-steel, knew nothing of the chemical composition of their product — yet the tremendous advance in iron and steel production of today would be impossible without modern chemistry.

The idea of utilizing the results of investigation in the field of physics and chemistry in the service of industry and trade, and of directing these researches toward utilitarian ends — a proceeding which seems so rational to the modern mind — has been adopted in a systematic manner only in recent times. The old-school experimenter disdained to direct his attention to commercially profitable processes and gave his whole thought to promoting pure science. On the other hand, those who were engaged in practical enterprises, tradespeople, knew only too little of the sciences and were unable to appreciate the importance of them in relation to their own businesses. Today we have a class of experts, trained both in pure science and in practical processes, who stand ready to utilize every attainment of science for the advantage of industry. This class of trained men, the engineers and practical chemists, forms the connecting link so long missing between the scholar and the entrepreneur, and modern industry owes a large part of its recent progress to this fact.

But going a step farther in the discovery of fundamental principles, our author has found a change in the natural sciences themselves — *the replacement of quality by quantity,* which finds its most perfect expression in the mathematical formula. The modern scientist weighs and measures, and invents instruments which record quantitative differences too small for the human senses to perceive. This has made many processes independent of human, and therefore fallible, perceptions. The science of bacteriology, especially, has resolved many differences of quality, as in beer-brewing, to very

minute differences of quantity. Following quantitative analysis comes the invention of intricate and extremely sensitive instruments by which these infinitely small differences can be measured, and man's dominion over nature is thereby widely extended.

In all this development, however, one of the consequences is the elimination of the human personality in industry, and this leads our author to the statement of the theory which is the subject of this paper: *the emancipation from the limitations of the organic.*[2] This principle means more than the elimination of the human personality in industry; it goes much farther and includes the gradual displacement of men, beasts, and even plants by inorganic materials. This principle runs through all nineteenth-century economic development and is a characteristic feature of the change from a handicraft to a factory — capitalistic economy.

Before the era of steam, the largest part of the motive force in industry was the muscular power of men and beasts. True, wind and water were extensively employed, but their limitations as regards space and time hindered their use in many ways, especially as neither of them were available for land transportation, hence the importance of the horse as a means of transportation. The invention of the steam engine and, later, of the electric motor dispensed with the use of the horse to a large extent, and emancipated commerce and industry from the limitations imposed by the more primitive means of traction and of motive power. Dr. Sombart has estimated that it would require at least five million horses to do the work of the locomotives in Prussia alone, and that one-fourth of the whole area of that kingdom would hardly suffice to furnish them with oats, to say nothing of the necessary hay.

The chemical industry has accomplished much in furthering this emancipation, especially the emancipation from the vegetable kingdom. The substitution of dyes made from coal-tar for those derived from plants furnishes a striking example of an industry freed from organic limitations; before, the dye-makers were dependent upon the crop of madder and other vegetable products for their supply of raw material; now they have at their disposal an inexhaustible supply of inorganic raw material always at hand. A small example out of hundreds is the manufacture of artificial honey-comb and honey, which substitutes a simpler organic for a complex organic product.

[2] *Die deutsche Volkswirtschaft im neunzehnten Jahrhundert,* chap viii, "Emanzipation von den Schranken des Organischen."

In practically every case this replacement of a simpler organic for a more complex, or of a complete change from an organic to an inorganic product, is accompanied by a cheapening of the commodity. The natural limitations of organic forms tend to make products and processes expensive. The expensiveness of organic forms arises from their perishability, or from their instability, or from the ground-space and labor necessary to produce them.

Two inorganic materials, coal and iron, have occasioned the most important change in the economic life of the world, and they have done this by replacing organic materials — wood, hemp, and leather — or by adapting themselves to uses for which no organic material could suffice. The use of coal as a fuel in the place of wood is the direct cause of the increased production of iron, which, in turn, has driven out wood to a large extent in the manufacture of machinery and in the building of houses, bridges, etc. Every tree growing upon the earth would long ago have had to be sacrificed to have provided the fuel and raw material for manufacturing which have been furnished by coal and iron. Here is, indeed, a sweeping away of limitations! Furthermore, lands which would otherwise be devoted to forestry are now cultivated fields, for as yet man has found no inorganic substitute for organic food materials.

By far the most important development in this process is the emancipation of industry from the highest organic form — man himself. It is true that we have no industry nor process which can dispense with the services of human control, but it is a fact of common knowledge that in practically every industry the participation of men in the process of production is decreasing steadily. Machines of intricate construction are performing work once done by the power of human muscles and the skill of human fingers. Every improvement in machinery which effects a saving of labor is a case of emancipation from the limitations of the organic, and consequently the substituting of a cheaper for a more expensive means. The factory is a complete expression of this tendency. Not only is the inorganic machine cheaper than human labor, but it is also more reliable. We have already mentioned measuring and weighing instruments which surpass the human senses in sensitiveness and exactness, as, for instance, the thermometer and the saccharometer.

Furthermore, the use of machines in the place of human labor has made possible a *uniformity of product* impossible in hand-work. This *standardization* of product means much in modern industry;

delicate parts of complicated machines can be replaced by exact duplicates without considerable delay or loss. Under what difficulties would not the Dakota farmer thresh his grain if the breaking of a small but necesary part of the steam-thresher would delay the use of the machine until a duplicate part could be made by a local artisan, if indeed it could be made at all! Modern automatic machinery make it possible to produce parts of threshers or any sort of machine all exactly alike and interchangeable, so that the loss of a part does not destroy the machine. The standardization of product means much also in the marketing of goods. Formerly it was necessary for the buyer to see the goods, or at least a sample of any particular lot. Now goods are made from certain patterns, or are of a certain standard quality, by the aid of machinery, which are absolutely uniform. It is no longer necessary for the buyer to make sure of the quality of a purchase by personal examination; the quality of a lot of goods can be exactly indicated by a few words.

One of the most serious limitations which arise in the use of organic material is the length of time necessary to production. Man has no skill to shorten the time necessary to raise a horse until he is strong enough to haul a street car, but he can produce additional electric motors on very short notice. The growth of a tree requires years, but the supply of coal stands ready for mining and for use as fuel whenever need therefor arises. The limitation of space in the use of the human voice has been overcome by the telephone. Thus limitations in both time and space are surmounted by inorganic means.

A very superficial survey of nineteenth-century economic development will suffice to reveal the fundamental importance of the principle under discussion. In manufacturing, the change from handicraft to factory system has meant the partial elimination of human brain and human muscle from the processes. The long years of apprenticeship required to learn the trade, the skill and muscular strength necessary at every stage of the manufacture, all these things have in large part been made superfluous by the machine, and the workman is called upon to furnish little more than a routine service and without special skill, mental or muscular power. Human personality is still required to organize and manage these processes, but the proportion of it to the amount of product has immensely decreased. The tendency in industry is to make production more and more automatic by the use of intricate machinery, and we may expect

in the future an ever greater elimination of the human personality from industry. Of the substitution of inorganic for organic materials we have already spoken: iron for wood in construction, coal for wood as fuel, coal-tar for vegetable products in dyeing, etc.

In agriculture, that branch of human activity which deals most exclusively with organic nature, the tendency toward the elimination of the organic is marked by the decline of the industry relative to those dealing with inorganic nature — manufacturing and mining. Furthermore, within the limits of agriculture itself and its branches, forestry and stock-raising, inorganic are replacing organic means in production. As in manufacturing, the increasing use of labor-saving and automatic machinery is effecting a decrease of human energy required per unit of product. Chemical — i. e., inorganic — fertilizers are coming more into use, supplementing the limited supply of organic fertilizers.

The emancipation from the limitations of the organic is one of the ways in which man asserts his mastery over nature. He frees himself from the slowness and unreliability of organic processes, and from the necessity of hard and ill-rewarded toil. Organic nature is the most difficult to control, hence he either conquers her or makes himself independent of her; this is the method of economic progress. As yet, he relies upon her for his most necessary requirement, food. Perhaps in the future he may be able even to produce his food by chemical means direct from the inorganic. For the immediate future, however, he must be content with utilizing inorganic means to aid him in producing his food more easily and with greater certainty from organic nature.

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SCHMOLLER'S POLITICAL ECONOMY

After more than forty years of penetrating research, Gustav Schmoller has given his *Outlines of Political Economy*[1] to his contemporaries. It is the result of systematic and scientific study by a man who has been one of the leaders in the work of enlarging and consolidating modern economics. To know how he looks upon the world and what he thinks of economic questions, is of the utmost importance to every student, and the recent publication of the second

[1] *Grundriss der Allgemeinen Volkswirtschaftslehre,* Vol. II. Leipzig: Duncker & Humblot, 1904.